PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-171145

(43)Date of publication of application : 11.07.1995

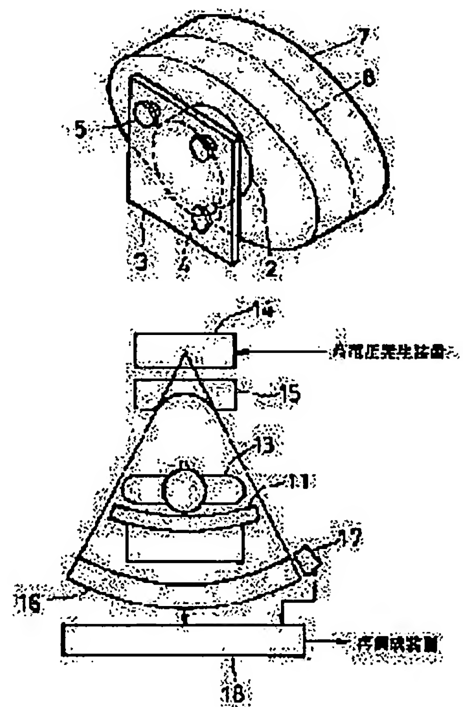
(51)Int.Cl. A61B 6/03

(21)Application number : 05-318856 (71)Applicant : TOSHIBA CORP

(22)Date of filing : 20.12.1993 (72)Inventor : OISHI HIROYUKI

(54) X-RAY CT DEVICE, AND PHANTOM FOR X-RAY CT DEVICE

(57)Abstract:



PURPOSE: To collect a precise calibration data by constituting a phantom as a flat sectional cylinder having a smooth circumference in a X-ray CT device in which measurement data is corrected on the basis of calibration data to provide a CT image.

CONSTITUTION: In an X-ray CT device for collecting the X-ray emitted from an X-ray tube 14 and transmitted by a subject 13 by an X-ray detector 16, and transmitting the detection data to a data collecting part 18 together with the output data of a referencer detector 17, this device is provided with a phantom to collect the calibration data prior to the photographing of the subject 13. This phantom is formed of a body 7 having an elliptic sectional columnar structure, and internally filled with water, a fixing base 3, and a connecting part 2, whereby the phantom X-ray is emitted to collect the calibration data. The measurement data obtained by the X-ray detector 16 is corrected on the basis of this calibration data, and the resulting data is reconfigured to provide a CT image.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

FA

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] Said phantom is an X-ray CT scanner with which it is characterized by constituting a perimeter as a barrel in which it has the cross section of a smooth flat configuration in the X-ray CT scanner which reconfigurates the data which irradiated the X-ray at analyte, obtained measurement data, amended this measurement data based on said calibration data, and were obtained after irradiating the X-ray at the phantom and collecting calibration data, and obtains CT image.
[Claim 2] The phantom for X-ray CT scanners characterized by constituting a perimeter as a barrel which has the cross section of a smooth flat configuration.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to an X-ray CT scanner, and relates to the structure of the phantom used in order to collect calibration data before analyte photography especially.
[0002]
[Description of the Prior Art] While development of medical diagnostic equipment is furthered in recent years, many X-ray CT scanners are used. An X-ray CT scanner makes analyte invade in the photography field where opposite arrangement of an X-ray tube and the X-ray detector was carried out, irradiates an X-ray beam from an X-ray tube, and collects the X-rays after analyte transparency with an X-ray detector. And the measurement data from each is obtained repeatedly, changing whenever [illuminating-angle / of an X-ray] for this actuation, it collapses in each measurement data, processing of reverse photography etc. is added, and CT image is reconfigurated.
[0003] In this way, as for CT image obtained, imaging of the difference in the CT valve of each organization in analyte is carried out as a difference in contrast. Therefore, it is necessary to decide a certain criteria to be a CT valve, and it is decided that the CT valve of water generally serves as zero. For this reason, before performing CT photography of analyte conventionally, false photography is performed using the phantom with which water was filled up, and calibration data are collected. And after the measurement data of analyte is collected, this calibration data is used, measurement data is amended, and CT image is reconfigurated using the amended data. That is, actuation which amends measurement data so that the CT valve of water may serve as zero using calibration data is performed.
[0004] Drawing 4 is the perspective view showing the configuration of the conventional phantom used in order to collect such calibration data. Like illustration, this phantom consists of a body 1 of the cylindrical shape with which it consists of the quality of the materials, such as an acrylic, and the interior is filled up with water, standing ways 3 for immobilization, and a connection 2, and the center line 6 for deciding the cap 4 for taking water in and out of a body 1 and an X-ray camera station is formed. Moreover, the pin 5 for connecting with the adjustment catch which is not illustrated is attached in standing ways 3.
[0005] And this phantom is laid on the berth of an X-ray CT scanner, X in all lines are irradiated in a photography cross-section location at a center line 6, and calibration data are collected. However, although the conventional phantom shown in drawing 4 is effective in case the cross-section configuration photos the part which is an approximate circle form like an analyte head since it has constituted the shape of a cylindrical shape for example, it is not suitable about the part the cross-section configurations of whose, such as a thorax and an abdomen, are not circular or configurations near it. That is, if it is similar with the cross-section configuration of analyte as much as possible, and it is [direction] good and configurations differ, the transparency distance of an X-ray, and amendment of an exact CT valve will become impossible [the cross-section configuration of a phantom] according to the phenomenon (the beam HADONINGU effectiveness) of the absorption coefficient of an X-ray changing with these. [the time of calibration data collection and actual measurement data collection]
[0006]
[Problem(s) to be Solved by the Invention] Thus, since the phantom in the conventional X-ray CT scanner was constituted by the cylindrical shape, on the occasion of photography of the thorax of analyte, and an abdomen, exact calibration data were not obtained but CT image reconfigurated had the fault of the artifact (false image) occurring.
[0007] The place which it was made in order that this invention might solve such a conventional technical problem, and is made into that purpose is to offer the phantom used for the X-ray CT scanner and this which can collect exact calibration data.
[0008]
[Means for Solving the Problem] In the X-ray CT scanner which reconfigurates the data which irradiated the X-ray at analyte, obtained measurement data, amended this measurement data based on

said calibration data, and were obtained after the X-ray CT scanner of this invention having irradiated the X-ray at the phantom and collecting calibration data, in order to attain the above-mentioned purpose, and obtains CT image, it is the description that said phantom was constituted as a barrel in which a perimeter has the cross section of a smooth flat configuration. Moreover, the phantom for X-ray CT scanners of this invention is characterized by constituting a perimeter as a barrel which has the cross section of a smooth flat configuration.

[0009]

[Function] According to this invention constituted like ****, since the cross-section configuration of a phantom is made into flat configurations, such as an ellipse, in case the thorax and abdomen of analyte are photoed, a cross-section configuration serves as abbreviation identitas. Therefore, it becomes possible to collect exact calibration data, and the image quality of CT image reconfigurated can be raised now.

[0010]

[Example] Hereafter, the example of this invention is explained based on a drawing. Drawing 2 is the block diagram of a common X-ray CT scanner, the analyte 13 laid on the top plate 11 of a berth 10 is sent in the photography field 12 of a stand 9 like illustration, and photography of the tomogram for a request part is performed.

[0011] Drawing 3 is the block diagram showing the photography system of an X-ray CT scanner. On both sides of the analyte 13 on a top plate 11, opposite arrangement of X-ray tube 14 and X-ray detector 16 is carried out like illustration, and the X-rays which it irradiated from the X-ray and penetrated analyte 13 are collected with X-ray detector 16. Moreover, the wedge filter 15 is formed in the output side of X-ray tube 14 so that an X-ray excessive to the circumference of analyte 13 may not be irradiated, and the reference detector 17 for amendment of an X-ray on the strength is further arranged in the flank of X-ray detector 16. And the output of X-ray detector 16 and the reference detector 17 is supplied to the data collection section 18.

[0012] Thus, with the constituted X-ray CT scanner, before photoing analyte, it is necessary to collect calibration data and a phantom as shown in drawing 1 is used by this example.

[0013] Like illustration, this phantom consists of a body 7 with which water was filled up with the prism structure of an ellipse in the cross-section configuration inside nothing, and the standing ways 3 and the connection 3 for immobilization. And the center line 8 for deciding the cap 4 for taking water in and out of a body 7 and an X-ray camera station is formed. Moreover, the pin 5 for following the fastener which is not illustrated is attached in standing ways 3.

[0014] Next, actuation of this example is explained. Before photoing analyte 13 (at for example, the time of system starting), the phantom shown in drawing 1 is first laid on the top plate 11 shown in drawing 2 , the center line 8 of the phantom concerned is set as a photography side, an X-ray is irradiated, and the X-rays after phantom transparency are collected as calibration data. And when time of day T and the calibration data of Channel n are set to Raq (n, T), it is shown like the following (1) type.

[0015]

[Equation 1]

Raq(n, T) =S(n, t) -I (n, T)

= S (n, t) and I0 (t) -exp {-integral(muaq+muw) ds}

.... (1)

However, sensibility I of S(n, t):X-ray detector 16 (n, t): X-ray intensity I0 which carries out incidence to X-ray detector 16 (T):incidence X-ray-intensity muaq: Linear-absorption-coefficient muw of water : Output [of the linear absorption coefficient of a wedge filter 15 and the reference detector 17 at this time] R (T) is shown by the following (2) types. R (T) =r (t) and I0 (T) .... (2)

However, r (t): The reference detector 17 ranks second the degree of admiration, and lay analyte 13 on a top plate 11, irradiate an X-ray, and collect measurement data. And when measurement data of time of day t and Channel n is set to Robj (n, t), it is shown like the following (3) types.

[0016]

[Equation 2]
Robj =(n, t) S(n, t) -I (n, t)
= S (n, t) and Io (t) -exp {-integral(muobj+muw) ds} .... (3)
However, muobj : Output [of the linear absorption coefficient of analyte 13 and the reference detector 17 at this time] R (t) is shown by the following (4) types.
[0017]
R (t) =r (t) and I0 (t) .... (4)
And amendment processing is performed based on the calibration data and measurement data which were shown by the above mentioned (1) - (4) formula, and it asks for the data (this is called raw data below) used in case it reconfigurates.
[0018] First, offset amendment is performed about measurement data Robj (n, t) and the calibration data Raq (n, T), and the data after offset amendment are made into R'obj (n, t) and R'aq (n, T), respectively. In this amendment, while you are not irradiating the X-ray, let the X-ray collected with X-ray detector 16 be zero.
[0019] Subsequently, logarithmic transformation is performed in order to change the detector output data after offset amendment into the integral value of the X-ray absorption multiplier which is input data of image reconstruction. That is, it becomes (5) - (8) type shown below.
<Measurement data> [0020]
[Equation 3]
ln[R'obj] (n, t) =ln[S (n, t), I0 (t), and exp(-integral(muobj+muw) ds)] = ln[S (n, t)] and ln[I0 (t)]+ln [exp (-integral(muobj+muw) ds)] .... (5)
ln [R(t)] =ln[-- r (t) and I0 -- (t) --] -- =ln[r(t)]+ln[-- I0 -- (t) --] -- .... (6)
<Calibration data> [0021]
[Equation 4]
ln [R'aq] (n, T) = ln [S (n, t) and I0 (T), and exp (-integral(muaq+muw) ds)] =ln[S(n, t)]+ln[I0 (T)]+ln [exp(-integral(muaq+muw) ds)]
.... (7)
ln [R(t)] =ln[-- r (t) and I0 -- (T) --] -- =ln[r(t)]+ln[-- I0 -- (T) --] -- .... (8)
However, in (5) - (8) type, although it multiplies by Ke=2363.64 in fact in order to make it the integer of 15 bits after logarithmic transformation, it omits here.
[0022] Next, change of the output reinforcement of an incidence X-ray is amended with the value outputted from the reference detector 17. It is subtracting subtraction of (6) types and (5) types, and (8) and (7) types, and, specifically, the result shown in (following 9) and following (10) types is obtained.
<Measurement data> [0023]
[Equation 5]
ln[R(t)]-ln[R'obj (n,t)]
= ln[r(t)]-[lnS(n, t)]-ln[exp (-integral(muobj+muw) ds) --]
.... (9)
<Calibration data> [0024]
[Equation 6]
ln[R(t)]-ln[R'aq (n,T)]
= ln[r(t)]-[lnS(n, t)]-ln[exp (-integral(muaq+muw) ds) --]
.... (10)
Then, it asks for raw data Raw (n, t) by subtraction with (9) types and (10) types. That is, they are the following (11) types.
[0025]
[Equation 7]
Raw(n,t) =ln[R(t) /R'obj (n,t)]-ln[R(T) /R'aq(n,T)]
=ln[R'aq (n,t)/R'obj (n,T)]
= integral(muobj-muaq) ds .... (11)
However, in (11) types, the sensibility of X-ray detector 16 is assumed to be what does not change in

time, and is made into t=T. And according to the (11) types, the effect by the wedge filter 15 and the difference in the sensibility of each detector are removed, and the raw data Raw (n, t) with which the CT valve of water serves as zero is obtained.

[0026] In this way, raw data can be obtained using calibration data and measurement data, and CT image of a high resolution can be obtained by reconfigurating this raw data.

[0027] Here, if (11) types are seen, the right-hand side is linear-absorption-coefficient muobj of analyte. It is the formula which integrated with difference with linear-absorption-coefficient muaq of water. That is, it will depend for raw data on each linear absorption coefficient of water and analyte greatly. Moreover, if the cross-section configuration of a phantom differs from the cross-section configuration of analyte greatly as the conventional example also explained, a linear absorption coefficient will change with beam HADONINGU effectiveness a lot. Therefore, about the analyte thorax or abdomen whose cross-section configuration is an abbreviation ellipse, if the phantom whose cross-section configuration is a circle is used as shown in drawing 4 , a linear absorption coefficient cannot change with the differences in the configuration, and exact calibration data cannot be obtained. So, in this example, by collecting calibration data using the phantom from which a cross-section configuration serves as an ellipse as shown in drawing 1 , exact calibration data can be obtained and the image quality of CT image comes to improve remarkably.

[0028] In addition, although the cross-section configuration explained the phantom of an ellipse in the above-mentioned example, this invention is not limited to this, but its perimeter of a cross section is smooth, and it cannot be overemphasized that it is applicable if the configuration is the thing of a flat configuration.

[0029]

[Effect of the Invention] As explained above, according to this invention, the cross section of a phantom can obtain calibration data exact since a perimeter is made into a smooth flat configuration, in case the thorax and abdomen of analyte are photoed, and the effectiveness that the image quality of CT image can be raised is acquired.

[Translation done.]

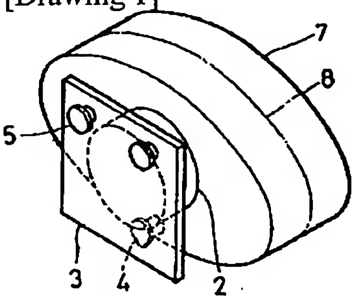
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective view showing the configuration of the phantom for X-ray CT scanners concerning one example of this invention.
[Drawing 2] It is drawing showing the appearance of a common X-ray CT scanner.
[Drawing 3] It is the block diagram showing the photography system of an X-ray CT scanner.
[Drawing 4] It is the perspective view showing the configuration of the conventional phantom for X-ray CT scanners.
[Description of Notations]
7 Body
8 Center Line
9 Stand
10 Berth
11 Top Plate
12 Photography Field
13 Analyte
14 X-ray Tube
15 Wedge Filter
16 X-ray Detector
17 Reference Detector
18 Data Collection Section

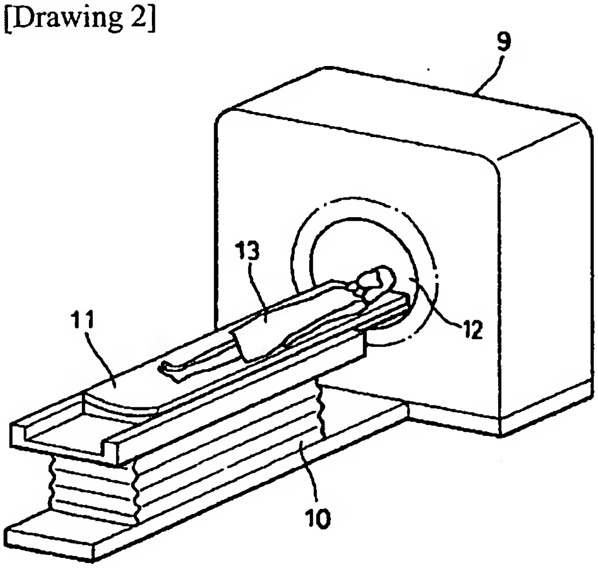
[Translation done.]

DRAWINGS

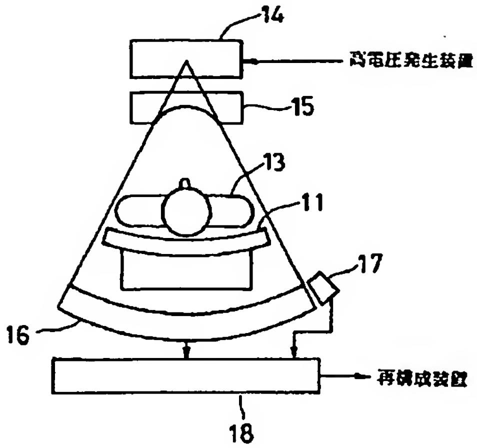
[Drawing 1]



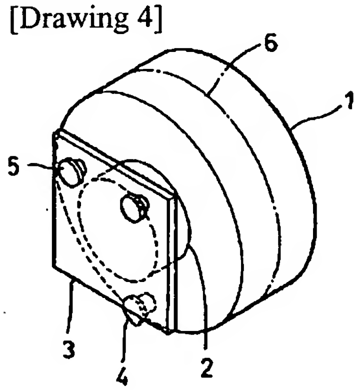
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]